

## 13.0 ROADWAYS

### 13.1 Administrative Requirements

The Contractor shall comply with the requirements of the following manuals and standards (latest versions at Proposal Due Date) for the design and construction of the Work for the Project.

#### 13.1.1 US 6, I-25, Federal Blvd., Bryant St., 5th Avenue, Interchange Ramps, Collector-Distributor Roads, Weir Gulch Trail and Platte River Bikeway

1. CDOT Roadway Design Guide
2. AASHTO, A Policy on Geometric Design on Highways and Streets
3. AASHTO, Roadside Design Guide
4. CDOT, Standard Plans List, M & S Standards
5. CDOT, Standard Specifications for Road and Bridge Construction
6. AASHTO, Guide for the Development of Bicycle Facilities
7. United States Access Board, ADA Accessibility Guidelines for Buildings and Facilities
8. United States Access Board, *Revised Draft Guidelines* for Accessible Public Rights-of-Way
9. State of Colorado, State Highway Access Code
10. City and County of Denver, Transportation Standards and Details for the Engineering Division

#### 13.1.2 Local Roadways

Local roadways include Federal Blvd., 5<sup>th</sup> Avenue, Bryant Street, Canosa Court and other non-CDOT roadways impacted by the Work.

Roadways controlled or maintained by local agencies other than CDOT shall be designed and constructed according to the local agency's standards and requirements. The additional manuals and standards are as follows:

1. City and County of Denver, Transportation Standards and Details For The Engineering Division
2. CCD, Traffic Signal Standards
3. CCD, Sign & Marking Standards.....
4. Other manuals and standards as required to complete the Work

## **13.2 Design Requirements**

### **13.2.1 Design and Plan Submittals**

In addition to the submittal requirements specified in this Section, the Contractor shall submit design and plan documents for CDOT Approval and Acceptance, as required in Book 2, Section 3 - Quality Management.

### **13.2.2 General Design Requirements by Project Element**

#### **13.2.2.1 Basic Configuration Accommodation**

The infrastructure constructed with the Project shall consider and accommodate the Basic Configuration, including but not limited to horizontal/vertical geometry and clearances to Structures.

The Contractor shall prepare and submit the preliminary design plan elements in consideration of the Basic Configuration for the Project and prior to issuance of Released for Construction plans, according to procedures of its Approved Quality Management Plan.

### **13.2.3 Cross Slope and Superelevation**

#### **13.2.3.1 Normal Cross Slope**

All new and reconstructed pavement sections shall have a normal cross slope of 2 percent.

For pavement widening sections, the widened section shall have a normal cross slope of 2 percent.

For overlay sections where the existing cross slope is equal or greater than 2 percent, the Contractor shall maintain the existing pavement cross slope. For overlay sections where the existing cross slope is less than 2 percent, the cross slope shall be built-up through the use of a variable thickness overlay to a minimum of 2 percent, unless documented otherwise for review by CDOT in advance of construction activities.

#### **13.2.3.2 Superelevation Rates**

Superelevation runout and runoff lengths for US 6, I-25, collector distributor roads, and interchange ramps shall be designed based on design criteria and methodology of AASHTO, A Policy on Geometric Design on Highways and Streets, the CDOT Roadway Design Guide, CDOT Standard Plans List of M & S Standards, and other requirements as determined appropriate by the Contractor

### **13.2.4 Stopping Sight Distance**

Stopping sight distances and decision sight distances shall meet or exceed the requirements of Exhibits 13-1 and 13-2 Roadway Design Criteria in this Section. Stopping sight distances shall be determined in accordance with the AASHTO, A Policy on Geometric Design on Highways and Streets and the CDOT Roadway Design Guide.

### **13.2.5 Fill and Cut Slopes and Clear Zones**

The Contractor shall design cut and fill slopes to obtain clear zones and avoid the need for guardrail wherever possible. Where clear zones cannot be obtained within CDOT ROW, guardrail shall be required.

Clear zones shall be designed in accordance with the recommendations of the AASHTO Roadside Design Guide.

#### **13.2.5.1 Roadside Slopes Adjacent to Pavement**

(Note: All slopes stated herein are in terms of horizontal: vertical)

The Point of Slope Selection (POSS) is defined as the location at which the roadside slope adjacent to the pavement ends and the cut or fill slope begins. Width and slope of the area between the edge of pavement (or sidewalk) and the POSS shall be as follows:

1. Mainline US 6 and I 25: 12 feet minimum at a 6:1 slope
2. Collector-distributor roads: 12 feet at a 6:1 slope
3. Ramps: 12 feet at a 6:1 slope
4. Curb and sidewalk areas: 2 feet at a 50:1 slope

#### **13.2.5.2 Fill Slopes**

Fill slopes beyond the POSS shall be designed and constructed in accordance with the following priority.

1. Use 6:1 slopes where fill heights are less than 4 feet, and matches with existing conditions that can be obtained within the Project limits.
2. Use 4:1 slopes where fill heights are greater than 4 feet but less than 10 feet, and matches with existing conditions that can be obtained within the Project limits.
3. Where the above conditions cannot be obtained, and as accepted as a variance by the Engineer, the Contractor may use any of the following design approaches:
  - A. Use 3:1 slopes with guardrail protection. Slopes steeper than 4:1 shall incorporate the use of soil retention blankets and shall be in compliance with the requirements of Section 17 - Landscaping.
  - B. Use retaining walls as necessary, with guardrail protection. Where retaining walls are used, provide a traversable surface with a maximum 6:1 cross slope and a minimum 10 feet width between face of wall and ROW or permanent easement line, fence line, or other obstruction.

Fill slope areas shall be designed to prevent Roadway and slope drainage from flowing onto adjacent properties.

#### **13.2.5.3 Cut Slopes**

Cut slopes beyond the POSS shall be designed and constructed in accordance with the following priorities:

1. Cut slopes must be transitioned at the match with the 6:1 slopes adjacent to Roadway pavement in such a manner to comply with the recommendations of the AASHTO Roadside Design Guide.
2. Use 4:1 or flatter slopes for cut slopes where matches with existing conditions can be obtained within the Project limits.
3. Where the above conditions cannot be obtained, and as accepted as a variance by the Engineer, the Contractor may use any of the following design approaches:
  - A. Use 3:1 slopes with guardrail protection. Slopes steeper than 4:1 shall incorporate the use of soil retention blankets and shall be in compliance with the requirements of Section 17 - Landscaping.
  - B. Use retaining walls as necessary, with guardrail protection to match existing conditions within the Project limits. Where retaining walls are used, locate to avoid landscaping and maintenance areas of less than 10 feet in width.

#### **13.2.6 - Intentionally Left Blank -**

#### **13.2.7 Guardrail**

Guardrail shall be required wherever clear zone requirements cannot be achieved.

Median barrier is required along the entire length of US 6 and I-25. Median barrier shall be concrete barrier with a concrete glare screen in accordance with CDOT Standard M-606-13.

Guardrail along outside shoulders of US 6, I-25, collector-distributor roads, and interchange ramps shall be concrete barrier where inlets are required for pavement drainage. Type 3 guardrail with asphalt curb will not be allowed for drainage accommodation.

All concrete barriers shall be cast-in-place. Precast barrier is not allowed for permanent installations.

#### **13.2.8 Access Design**

The Contractor shall construct connecting roads, driveways, or curb cuts to provide access to property parcels where existing accesses have been disturbed or modified. Access design and location shall conform to the following requirements, in the order of precedence listed:

1. Access locations and restrictions delineated on the ROW Plans in Book 4
2. Access locations as required for maintenance operations
3. State of Colorado, State Highway Access Code
4. CCD permit requirements

Connecting roads and driveways shall be paved to the ROW limits using similar pavement as the adjacent roadway, and shall be replaced in conformance to the above requirements to the limits required to match existing grade.

### **13.2.9 Bikeway**

#### **13.2.9.1 Bikeway Values**

The Platte River Bikeway is an existing commuter facility. The Bikeway design shall:

1. Conform to CCD safety requirements.
2. Not increase out-of-direction travel from the existing configuration.
3. Provide horizontal and vertical separation from mainline US 6 and I 25 that minimizes the need for barrier separation from the Roadway.
4. Meets all other CCD requirements.

### **13.2.10 Design Exceptions**

#### **13.2.10.1 Identified Design Exceptions**

Design Exceptions (DEs) and Design Decision (DDs) that have been identified by CDOT and may be required for this Project are included in the Reference Documents as related to specific elements of the reference drawings. Design Exceptions required for the Contractor's design shall be obtained by the Contractor in accordance with the following requirements:

#### **13.2.10.2 Design Exception Process**

The Contractor shall comply with the following requirements when requesting a Design Exception to the requirements herein:

1. The Contractor shall submit Design Exception requests in the form of a letter addressed to the CDOT Project Director for Approval prior to issuance of applicable Released for Construction Documents.
2. The Design Exception request shall consist of the following items:
  - A. A letter identifying the exception(s) by number, Project number, location, and status (new submittal, resubmittal, etc.)
  - B. A completed CDOT Form 464a
  - C. Supporting documentation indicating the justification for the Design Exception. Justification shall address the following items:
    - (1) Site conditions of the exception.
    - (2) Compelling reason for the exception, including which standard is not being met. If the exception affects any other standards, state what will be done to mitigate the effects of the exception.
    - (3) Effects of the exception on safety and operation of the facility.
    - (4) Previous crash history near the location of the exception.
    - (5) Calculations estimating the cost of attaining the design standard and costs of exception as proposed.
    - (6) Effect on scenic, historical, or other environmental features.
  - D. Plan and profile drawings depicting the exception.

## 13.3 Construction Requirements

### 13.3.1 Guardrail

In areas that allow use of Type 3 guardrail, the Contractor shall use galvanized guardrail (Standard Plan No. M606-1) with steel posts. The Contractor shall pave asphalt a minimum of 1 foot behind the new guardrail posts.

### 13.3.2 Median Cover Material

Median cover material for raised medians constructed by the Project shall match color and texture of median cover material constructed on adjacent roadways.

### 13.3.3 Fencing

#### 13.3.3.1 Temporary Fencing

Installation of temporary fencing will be required to protect adjacent private property. In remaining areas, temporary fencing should be considered to control construction operations and avoid impacts beyond ROW limits. Temporary fence shall be placed as may be required in any other section of the Contract.

#### 13.3.3.2 Permanent Fencing

Provide permanent fencing of types and at locations in Table 13.3-1.

| Table 13.3-1<br>PERMANENT FENCING TYPES      |      |                           |
|--|------|---------------------------|
| Location                                     | Type | Remarks                   |
| Right-of-Way line                            | -    | Per CDOT Standard M-607-2 |
| Access control between bikeway and US 6/I-25 | -    | Per CDOT Standard M-607-2 |
| Water quality/detention ponds                | -    | Per CDOT Standard M-607-2 |

#### 13.3.3.3 Gates

Provide gates in fences at locations, width and type as specified by requirements of the Contract or other maintaining entities for maintenance access, including CDOT.

## 13.4 Deliverables

At a minimum, the Contractor shall submit the following to CDOT for review, Approval, and/or Acceptance:

| Deliverable   | Review, Acceptance, or Approval | Schedule  |
|---|---------------------------------|---|
| Overlay sections where the existing cross slope is less than 2 percent and cannot be built-up through the use of a variable thickness overlay to a minimum of 2 percent, and documented otherwise by the Contractor | review                          | In advance of construction activities.                              |
| Design Exceptions   | Approval                        | Prior to issuance of applicable Released for Construction Documents |

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**BR 0061-083, SUB ACCOUNT 18838 (CN)**  
**BOOK 2 TECHNICAL REQUIREMENTS**  
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**Exhibit 13-1 – Roadway Design Criteria**

| DESIGN ELEMENT (CONTINUED)                         |  | I-25                     | 6TH AVE (WEST OF PLATTE RIVER) | 6TH AVE (EAST OF PLATTE RIVER) |
|--|--|--------------------------|--------------------------------|--------------------------------|
| <b>Roadway Classification</b>                      |  |                          |                                |                                |
| Roadway Classification                             |  | Interstate - Urban       | Principle Arterial - Urban     | Principle Arterial - Urban     |
| Access Control Classification                      |  | Interstate (Full)        | -                              | -                              |
| Design Speed                                       |  |                          |                                |                                |
| Minimum (MPH)                                      |  | 60                       | 65                             | 55                             |
| Posted Speed Limit Minimum (MPH)                   |  | 55                       | 55                             | 45                             |
| Design Vehicle                                     |  | WB-67                    | WB-67                          | WB-67                          |
| <b>Horizontal Alignment Criteria</b>               |  |                          |                                |                                |
| Curve Radius For Design Speed Minimum (Ft.)        |  | 1330'                    | 1660'                          | 1060'                          |
| Superelevation ( $e_{max}$ )                       |  | 6%                       | 6%                             | 6%                             |
| Max. Degree of Curve - Design Speed (Calculated)   |  | 4.31                     | 3.45                           | 5.41                           |
| Cross Slope - Normal                               |  | 2%                       | 2%                             | 2%                             |
| Maximum Algebraic Difference at Crossover Line (%) |  | 4 to 5%                  | 4 to 5%                        | 4 to 5%                        |
| Clear Zone (On Tangent)                            |  |                          |                                |                                |
| Minimum  |  | 30'                      | 30'                            | 22'                            |
| Clear Zone (On Curve)                              |  |                          |                                |                                |
| Minimum  |  | 42'                      | 42'                            | 33'                            |
| Lane Width (Ft.)                                   |  | 12'                      | 12'                            | 12'                            |
| Shoulder Widths                                    |  |                          |                                |                                |
| Left Inside (Ft.)                                  |  | 12'                      | 12'                            | 12'                            |
| Right Outside (Ft.)                                |  | 12'                      | 12'                            | 12'                            |
| Curb and Gutter Type                               |  | N/A                      | N/A                            | N/A                            |
| Sidewalk Widths                                    |  | N/A                      | N/A                            | N/A                            |
| Side Ditches                                       |  |                          |                                |                                |
| Z slope (6:1)                                      |  | 12'                      | 12'                            | 12'                            |
| Fill Slope   |  | 2:1 to 6:1               | 2:1 to 6:1                     | 2:1 to 6:1                     |
| Cut Slope  |  | 3:1                      | 3:1                            | 3:1                            |
| Redirect Taper (Ft.)                               |  | 65:1 min.                | 65:1 min.                      | 65:1 min.                      |
| Transition Taper for Accel/Decel Lanes             |  | 25:1 min.                | 25:1 min.                      | 25:1 min.                      |
| Taper Length Roadway Lane Drop                     |  | 70:1 Desirable 50:1 min. | 70:1 Desirable 50:1 min.       | 70:1 Desirable 50:1 min.       |

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**Exhibit 13-1 – Roadway Design Criteria (Cont.)**

| DESIGN ELEMENT (CONTINUED)                           |  | I-25                | 6TH AVE (WEST OF PLATTE RIVER) | 6TH AVE (EAST OF PLATTE RIVER) |
|--|--|---------------------|--------------------------------|--------------------------------|
| <b>Vertical Alignment Criteria</b>                   |  |                     |                                |                                |
| Maximum Grade  |  | 4%                  | 6%                             | 6%                             |
| Minimum Grade  |  | 0.30%               | 0.30%                          | 0.30%                          |
| Min. Vertical Grade Break without a Curve            |  | 0.20%               | 0.20%                          | 0.20%                          |
| Min. Vertical Curve Length (Ft.)                     |  | 180'                | 195'                           | 180'                           |
| <b>K-Value Ranges</b>                                |  |                     |                                |                                |
| Crest VC (Minimum)                                   |  | 151                 | 193                            | 114                            |
| Sag VC (Minimum)                                     |  | 136                 | 157                            | 115                            |
| <b>Sight Distances</b>                               |  |                     |                                |                                |
| Level (Minimum)                                      |  | 570'                | 645'                           | 495'                           |
| 3% Downgrade (Minimum)                               |  | 598'                | 682'                           | 520'                           |
| 3% Upgrade (Minimum)                                 |  | 538'                | 612'                           | 469'                           |
| <b>Interchanges Parallel Type Ent./Ex. Terminals</b> |  |                     |                                |                                |
| Taper Length Taper Entrance Terminal (L>1300 Ft.)    |  | between 50:1 & 70:1 | between 50:1 & 70:1            | between 50:1 & 70:1            |
| Taper Length Parallel Entrance Terminal (L<1300 Ft.) |  | 300' Minimum        | 300' Minimum                   | 300' Minimum                   |
| Taper Length Parallel Exit Terminal                  |  | between 15:1 & 25:1 | between 15:1 & 25:1            | between 15:1 & 25:1            |
| <b>Structure Clearance Criteria</b>                  |  |                     |                                |                                |
| Highway Underpass Vertical (Ft.)                     |  | 16.5'               | 16.5'                          | 16.5'                          |
| Local Road Underpass Vertical (Ft.)                  |  | 16.5'               | 16.5'                          | 16.5'                          |
| Railroad Structure (Ft.)                             |  | 23.5'               | 23.5'                          | 23.5'                          |
| Sign Structures and Pedestrian Overpass (Ft.)        |  | 17.5'               | 17.5'                          | 17.5'                          |
| Overhead Power Lines Vertical (Ft.)                  |  | 20.5' to 21.5'      | 20.5' to 21.5'                 | 20.5' to 21.5'                 |



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**Exhibit 13-2 – Roadway Design Criteria**

| DESIGN ELEMENT (CONTINUED)                         |                            | 6TH AVE CD ROAD            | LOOP RAMPS                    | INTERCHANGE RAMPS          | FEDERAL BLVD |
|--|----------------------------|----------------------------|-------------------------------|----------------------------|--------------|
| <b>Roadway Classification</b>                      |                            |                            |                               |                            |              |
| Roadway Classification                             | Collector-Distributor Road | Interchange Ramps          | Interchange Ramps             | Principle Arterial - Urban |              |
| Access Control Classification                      | -                          | -                          | -                             | -                          |              |
| Design Speed                                       |                            |                            |                               |                            |              |
| Minimum (MPH)                                      | 55                         | 25                         | 50/45/30                      | 40                         |              |
| Posted Speed Limit Minimum (MPH)                   | 45                         | N/A                        | N/A                           | 35                         |              |
| Design Vehicle                                     | WB-67                      | WB-67                      | WB-67                         | WB-67                      |              |
| <b>Horizontal Alignment Criteria</b>               |                            |                            |                               |                            |              |
| Curve Radius For Design Speed Minimum (Ft.)        | 1060'                      | 144'                       | 833'/643'/231'                | 485'                       |              |
| Superelevation (e <sub>max</sub> )                 | 6%                         | 6%                         | 6%                            | N/A                        |              |
| Max. Degree of Curve - Design Speed (Calculated)   | 5.41                       | 24.8                       | 6.88                          | 11.8                       |              |
| Cross Slope - Normal                               | 2%                         | 2%                         | 2%                            | 2%                         |              |
| Maximum Algebraic Difference at Crossover Line (%) | 4 to 5%                    | 4 to 5%                    | 4 to 5%                       | 4 to 5%                    |              |
| Clear Zone (On Tangent)                            |                            |                            |                               |                            |              |
| Minimum  | 20'                        | 14'                        | 20'                           | 14'                        |              |
| Clear Zone (On Curve)                              |                            |                            |                               |                            |              |
| Minimum  | 33'                        | 21'                        | 28'                           | 20'                        |              |
| Lane Width (Ft.)                                   | 12'                        | 15'                        | 12' (2 lanes)<br>15' (1 lane) | 11'                        |              |
| Shoulder Widths                                    |                            |                            |                               |                            |              |
| Left Inside (Ft.)                                  | 4'                         | 4'                         | 4'                            | -                          |              |
| Right Outside (Ft.)                                | 12'                        | 6' (1 lane)<br>8' (2 lane) | 6' (1 lane)<br>8' (2 lane)    | -                          |              |
| Curb and Gutter Type                               | Type 2 (Section I-B, II-B) | N/A                        | Type 2 (Section I-B, II-B)    | Type 2 (Section I-B, II-B) |              |
| Sidewalk Widths                                    | N/A                        | N/A                        | N/A                           | 8'                         |              |
| Side Ditches                                       |                            |                            |                               |                            |              |
| Z slope (6:1)                                      | 12'                        | 12'                        | 12'                           |                            |              |
| Fill Slope   | 2:1 to 6:1                 | 2:1 to 6:1                 | 2:1 to 6:1                    | 2:1 to 6:1                 |              |
| Cut Slope  | 3:1                        | 3:1                        | 3:1                           | 3:1                        |              |
| Redirect Taper (Ft.)                               | 65:1 min.                  | 25:1                       | 65:1 min.                     | 65:1 min.                  |              |
| Transition Taper for Accel/Decel Lanes             | 25:1 min.                  | 25:1 min.                  | 25:1 min.                     | 25:1 min.                  |              |
| Taper Length Roadway Lane Drop                     | 70:1 Desirable 50:1 min.   | 70:1 Desirable 50:1 min.   | 70:1 Desirable 50:1 min.      | 70:1 Desirable 50:1 min.   |              |

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**Exhibit 13-2 – Roadway Design Criteria (Cont.)**

| DESIGN ELEMENT (CONTINUED)                           |  | 6TH AVE CD ROAD     | LOOP RAMPS     | INTERCHANGE<br>RAMPS                                  | FEDERAL BLVD   |
|--|--|---------------------|----------------|---|----------------|
| <b>Vertical Alignment Criteria</b>                   |  |                     |                |   |                |
|  |  |                     |                | 3%-5% (45-50 mph)<br>4%-6% (40 mph)<br>7% (25-30 mph) |                |
| Maximum Grade  |  | 7%                  | 7%             |   | 7 %            |
| Minimum Grade  |  | 0.30%               | 0.30%          | 0.30%   | 0.3%           |
| Min. Vertical Grade Break without a Curve            |  | 0.20%               | 0.20%          | 0.20%   | 0.20%          |
| Min. Vertical Curve Length (Ft.)                     |  | 165'                | 75'            | 150'  | 120'           |
| <b>K-Value Ranges</b>                                |  |                     |                |   |                |
|  | Crest VC (Minimum)                                   | 114                 | 12             | 84/61/19  | 44             |
|  | Sag VC (Minimum)                                     | 115                 | 26             | 96/79/37  | 64             |
| <b>Sight Distances</b>                               |  |                     |                |   |                |
|  | Level (Minimum)                                      | 495'                | 155'           | 425'/360'/200'  | 305'           |
|  | 3% Downgrade (Minimum)                               | 520'                | N/A            | 446'/378'/205'  | 315'           |
|  | 3% Upgrade (Minimum)                                 | 469'                | 155'           | 405'/344'/200'  | 289'           |
| <b>Interchanges Parallel Type Ent./Ex. Terminals</b> |  |                     |                |   |                |
|  | Taper Length Taper Entrance Terminal (L>1300 Ft.)    | between 50:1 & 70:1 | N/A            | N/A   | N/A            |
|  | Taper Length Parallel Entrance Terminal (L<1300 Ft.) | 300' Minimum        | N/A            | N/A   | N/A            |
|  | Taper Length Parallel Exit Terminal                  | between 15:1 & 25:1 | N/A            | N/A   | N/A            |
| <b>Structure Clearance Criteria</b>                  |  |                     |                |   |                |
|  | Highway Underpass Vertical (Ft.)                     | 16.5'               | 16.5'          | 16.5'   | 16.5'          |
|  | Local Road Underpass Vertical (Ft.)                  | 16.5'               | 16.5'          | 16.5'   | 16.5'          |
|  | Railroad Structure (Ft.)                             | 23.5'               | 23.5'          | 23.5'   | 23.5'          |
|  | Sign Structures and Pedestrian Overpass (Ft.)        | 17.5'               | 17.5'          | 17.5'   | 17.5'          |
|  | Overhead Power Lines Vertical (Ft.)                  | 20.5' to 21.5'      | 20.5' to 21.5' | 20.5' to 21.5'  | 20.5' to 21.5' |